Forest Analysis & Inventory Branch

Ministry of Forests and Range

Final Report on the Status of Inventory and Monitoring Projects Funded Through the Federal Mountain Pine Beetle (FMPB) Program

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Ministry of Forests and Range
Forest Analysis and Inventory Branch

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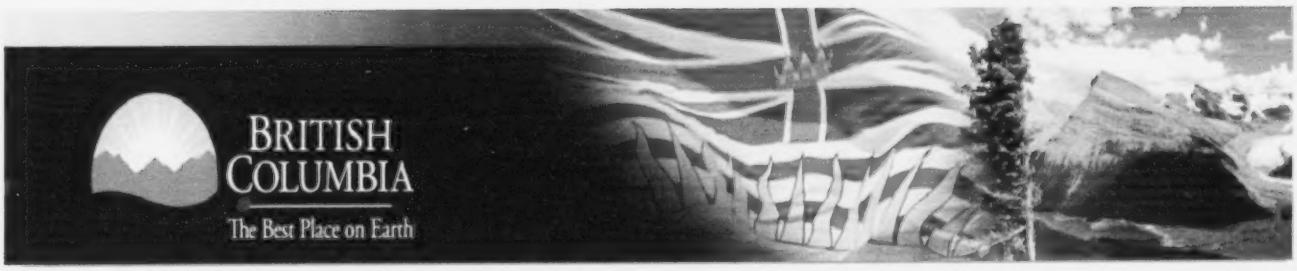

Executive Summary

Background

The federal and provincial governments provided funding for inventory and monitoring projects to collect critical information on MPB location and extent, impacts on timber volume and value, and impacts on critical non-timber resources in response to the unprecedented MPB outbreak in B.C.'s central interior. A total of $11.54m was provided to support inventory and monitoring projects across the entire infestation from the $100m allocated to the province from the federal government as part of the original 2005 agreement. This funding was allocated over a three-year period to a number of projects focussed by an overall project management framework, resulting in a significant number of accomplishments over the 2005 to 2008 period, including the following:.

- Air photo acquisition across the entire infestation;
- Ground sampling, including shelf-life sampling, establishment and measurement of monitoring plots, enhanced VRI phase 2 sampling, and calibration of the MPB spread model;
- Development of retrospective change detection and a MPB map of the dead and shelf-life model across the entire infestation;
- Site productivity sampling in three critical management units;
- Inventory project planning support;
- Development of innovative air and ground sampling techniques to capture understory information; and
- Non-timber inventory work in critical watersheds and an eco-regional assessment for the central interior.

The above projects or project themes focussed on the collection of information considered critical to the province in determining the location and extent of current and future infestations as well as the impacts on timber and non-timber resources. The results of these projects support a number of key business needs including operational planning, strategic forest resource management decision making, TSR analyses, guidance for mitigation activities and forest harvesting, development of silviculture strategies, and spatial definition of the FFT footprint to guide site rehabilitation efforts.

These projects were identified and administered under a project management framework that spanned MFR, MOE and ILMB and involved a number of key stakeholders including industry. Only projects that had been identified as meeting critical goals of government were prioritized and approved for funding, in accordance with the Mountain Pine Beetle Emergency Response - Canada-B.C. Implementation Strategy and the provincial MPB Action Plan. A steering committee was established for oversight of all work and projects were reviewed on an annual basis. In certain projects synergies were

found with other funding sources, for example with FIA for topping up support needed to carry out site productivity work in three critical management units.

A number of gaps have been identified as requiring resources after March 31, 2008, the date beyond which FMPB funding is no longer available for MPB related inventory and monitoring work. These gaps will be filled through FFT funding in management units hardest hit by the epidemic and will largely focus on spatially defining the FFT footprint, providing support for the continuation of updates on MPB location and extent, completing our commitment to improving site productivity information, and modifications to any of our MPB modeling and analyses as needed as part of the Ministry's engagement on complex stands. Completing these gaps will entail ongoing close coordination with FIA and the roll-out of VRI phase 1 and 2 inventory projects in critical management units.

A number of recommendations stem from our experience administering the 2005 to 2008 work, including the scope and types of projects that should be continued under the FFT funding source, where these should be carried out, and how administration may be improved. As well, there are a number of recommendations pertaining to improvements in communications and coordination of projects and management of the information, including improvements in the efficiency and quality of imagery.

Intended Audience for this Report

This report has been prepared for the Federal MPB program leads, Forests for Tomorrow (FFT) managers, and Forest Analysis and Inventory Branch (FAIB) managers. It is also a compendium for reference by auditors and others engaged in future related activities focussed on addressing any noted gaps in our information with respect to MPB.

Purpose of this Report

The purpose of this report is to provide a current summary of all inventory and monitoring projects that were conducted using FMPB funds over the past three years. Brief project descriptions are provided together with accomplishments and identification of any remaining gaps. A number of recommendations are also provided to guide future investments in inventory and monitoring data collection through other funding sources such as the Forest Investment Account (FIA) and FFT.

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Introduction

The Mountain Pine Beetle (MPB), an endemic species of bark beetle adapted to infesting and killing older aged pine trees, has become epidemic in recent years in British Columbia. It threatens to kill 80 to 95 per cent of the mature pine in central B.C. and has the potential to spread across the boreal forest to impact most of western and central Canada. British Columbia has been working tirelessly to stop the spread of the beetle within the province, but the infestation, promoted by large areas of mature pine and warm winters, has spread to most areas of susceptible forests. In February 2005, B.C. appealed to the Government of Canada for financial assistance to help manage the MPB issues. In response, Canada offered a contribution of $100 million, publicly stating that the two governments would work together on the issue.

Subsequently, a number of key programs areas were identified as being crucial to offsetting impacts due to MPB, among them inventory. A number of agencies noted that critical information on MPB location and extent, affected timber volume, future MPB spread and impacts on timber and non-timber resources. A total of $11.54 million was then allocated over a three-year period from 2005 to 2008 to support collection of information considered critical to provide support to mitigation activities and guide various forest management decisions and actions needed to address MPB related impacts in affected management units. A committee was established to provide project oversight and a number of inter-agency technical working groups were initiated. A project administration framework was developed in-line with high level federal and provincial goals and objectives and which included project selection criteria, funding allocations and ongoing project management.

This report provides an overview of the FMPB funded inventory and monitoring projects that were then delivered in the 2005-2008 timeframe, together with an explanation of the business drivers that were employed to guide MPB inventory and monitoring project priorities and the process used for administration of these projects. A synopsis of accomplishments and noted gaps is also provided along with some recommendations since the original intent of the Federal-Provincial agreement was for additional funding to address MPB impacts beyond 2008 and such funding has since been dropped to support any additional inventory and monitoring work.

Federal MPB Goals and Objectives

The following is a brief overview of the FMPB program objectives and goals specific to MPB and inventory. These objectives and goals provided the overall strategic framework and business drivers for inventory and monitoring work that was undertaken in MPB impacted management units over the three-year period from 2005 to 2008. Federal MPB goals and objectives were articulated in the Mountain Pine Beetle Emergency Response - Canada-B.C. Implementation Strategy that was developed between the federal and provincial governments. These drivers were then more specifically articulated in the provincial MPB Action Plan, briefly covered below as well.

Federal Priorities

To assist BC in meeting its costs to combat MPB spread and mitigate damage the federal government noted six areas of federal priority, they are:

1. Delivering additional control measures to reduce the spread;
2. Protecting sensitive fish streams/rivers and species at risk;
3. Undertaking fuel management on lands surrounding high-risk communities;
4. Continued development of additional markets and products;
5. Scientific and operational research to improve processes for existing products and developing new ones as well as developing existing and new markets; and,
6. Undertaking long-term strategic planning for communities and First Nations to respond to changes arising from the infestation.

Funding Strategy

The 2006-2011 Mountain Pine Beetle Action Plan served as the cornerstone of the B.C. government's coordinated response to the MPB infestation. In the Action Plan, the Province committed to actions to mitigate the impacts of this unprecedented attack on forest values, communities and the provincial economy in the short term, and ensure sustainability in the long term. It provided a high-level framework to direct provincial ministries and assist coordination between all levels of government, First Nations, industries and stakeholders. With the federal government's six priorities in mind, the Province distributed the balance of the $100 million across activities consistent with the objectives of the MPB Action Plan. Inventory was one of nine components funded under this strategy from the $100m allocated over the three-year period.

Provincial MPB Action Plan Goals and Objectives

The Province developed the Mountain Pine Beetle Action Plan 2006-2011 to articulate a set of goals and objectives to mitigate the impacts from MPB on timber resources, non-timber values, and on the socio-economic front in communities at risk from the epidemic.

Inventory and monitoring projects were prioritized and undertaken in order to meet a number of the goals expressed in the provincial MPB Action Plan, specifically Objective #6. A total of seven objectives are laid out in this plan, as follows:

- Objective 1 - Conserve the long-term forest values identified in land use plans
- Objective 2 - Encourage immediate and long-term economic sustainability for communities
- Objective 3 - Maintain and protect worker and public health and safety
- Objective 4 - Recover the greatest value from dead timber before it burns or decays, while respecting other forest values
- Objective 5 - Prevent or reduce damage to forests in areas that are susceptible but not yet experiencing epidemic infestations
- Objective 6 - Restore the forest resources in areas affected by the epidemic
- Objective 7 - Maintain a management structure that ensures the effective and coordinated planning and implementation of mitigation measures

Of these objectives, Objective 1, Objective 2, Objective 4, Objective 5 and especially Objective 6 have been supported by inventory and monitoring projects that were prioritized and undertaken specifically with these objectives in mind. Further details of this MPB action plan can be found at:

http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/actionplan/2006/Beetle_Action_Plan.pdf

Objective #6
Restore the forest resources in areas affected by the epidemic.

a) Inventory

Funding Distribution

Fiscal 2005/06:	$2.68 million
Fiscal 2006/07:	$2.51 million
Fiscal 2007/08:	$6.35 million
Total:	$11.54 million (Original Estimate)

Description
This activity addressed the challenge of providing up-to-date timber and non-timber inventory information for resource managers, given the rapidly changing dynamics of the forest as a result of the MPB infestation. The funding was only to support inventory work that was specifically aimed at beetle infestation issues and mitigation analysis work. The focus was on current inventory measurement to support a more accurate "snapshot in time" of what timber volumes and non-timber values have been affected by the infestation. This early, periodic inventory information has aided spread and mitigation control planning and support decisions to increase harvesting, as well as manage other non-timber resource allocation decisions. This program has included aerial photography,

inventory and data management of affected First Nations' interest areas. Inventory work has occurred under four main categories:

- Monitoring forest resources (imagery and on the ground verification);
- Monitoring non timber resource values;
- Base mapping; and,
- Land status updates.

Of the total estimated funding of $11.54m above a final total estimate of $10.1m was spent on operations, i.e. funding that directly covered projects over the three-year period. An additional $0.6m or $600,000 of FMPB funding covered salaries and other administrative overhead for the additional staff resources needed. Over the course of the programme some funding had also been reduced by approximately $800,000 and recovered based on critical needs in other programme areas and an inventory overachievement of its corporate performance measure (number of mapsheets flown per year). Future funding was proposed that would focus on longer-term needs to re-inventory affected areas and develop new baseline information for ongoing timber supply analyses to support allowable annual cut determinations and the ongoing management of non-timber forest resources.

Outcomes Anticipated at the End of the Program

The objective of this support program was to ensure that the various mitigation initiatives that require land, inventory and mapping information received the resources needed to accomplish their tasks. As the overall need far exceeds the funding, information acquisition investments had to be well-planned to achieve maximum benefit. The primary short-term objective was to provide planning information on the spread of the beetle to support the spread control, salvage and follow-up mitigation programs. Under this program, approximately 1300 to 1400 mapsheets have been completed, resulting in over 20 million hectares of coverage. . As well, a number of ground survey projects such as shelf-life sampling, calibration and modified VRI Phase 2 sampling will be completed in affected management units by March 2008.

Ongoing inventory support will be needed for the entire 30 years of mitigating the beetle impacts. Potential funding sources for future inventory support are the Ministry of Forests and Range's Forest for Tomorrow Program and the FIA Land Base Investment Program with the termination of Federal funding for MPB related inventory and monitoring.

MPB Inventory and Monitoring Strategy

To ensure all business needs were considered, a strategy was developed in June, 2005 for inventory and monitoring in MPB which laid out a number of business requirements, in four themes or business areas, as follows:

1) The location and extent of the mortality;

2) The volume and value of attacked stands;
3) Corporate decisions such as AAC uplifts, which areas should be harvested or not, and silviculture strategies, and
4) Technical matters such as database structures and modelling requirements.

These themes or business areas were defined for the purpose of project prioritization and administration, based on the goals and objectives expressed in the Mountain Pine Beetle Emergency Response - Canada-B.C. Implementation Strategy, the provincial MPB Action Plan, and the MPB Inventory and Monitoring Strategy.

The June 17, 2005 report, *Strategies for Inventories and Monitoring In Mountain Pine Beetle Areas*[1] provided the strategic framework needed to undertake necessary activities and possibly transform our approaches to forest inventory in the MPB-affected areas. Further details are available in this report at the following location:

http://www.for.gov.bc.ca/hts/MPBStrategy/StrategyReport_Final_Jun17.pdf

Project Management Framework and Approach

All inventory and monitoring projects were prioritized and administered on annual basis through an established team of inter-agency representatives and through adoption of a consistent project management framework. Work was coordinated with FIA and FFT activities to ensure that there was no overlap or duplication within management units. As well, FMPB funded work was frequently augmented by other funding sources, for example by licensees for site productivity work and the Quesnel VRI pilot and by FFT for the analysis projects. In addition, the team reviewed projects in on ongoing manner throughout each fiscal year. Project status was also regularly reported out to the inter-agency Federal Working Group Team.

Establishment of an inter-agency team

The Inventory and Timber Analysis Team (ITAC) was established to strategically manage FMPB funded information for FFT and other program decision-making in a timely, cost effective and coordinated manner in response to the MPB Action Plan, FFT Work Plan and in line with the strategic framework developed in the Strategies for Forest Inventory and Monitoring in MPB Areas. A number of technical working groups and specialists were guided through ITAC, including an air photo planning and review team, a remote sensing team, VRI specialists, and licensees and stakeholders engaged in inventory pilots in affected management units such as Quesnel.

This committee is expected to function beyond the current 2008 limit of FMPB funding with a purpose to continue to:

1. Provide decision support and risk analysis for inventory, timber supply and the FFT program;
2. Provide co-ordination of business flow processes for information management and reporting;
3. Provide due diligence of provincial and federal investments in long-term timber supply through free-growing stands (FFT) and other mitigating treatments; and,
4. Provide value for money through harmonizing projects with different funding eligibility, including the identification of any overlaps or gaps in project activities and outcomes.

The committee function includes strategic, operational and business process direction and priority-setting for inventory and timber supply analysis in support of the many aspects of the Forests for Tomorrow (FFT) program, Federal, and any other funding sources that could arise. The committee also ensures due diligence of FMPB and FFT funded inventory and timber supply projects.

Project Eligibility and Selection Criteria

A standard set of project eligibility and selection criteria was developed and adopted by the team in order to best assess proposed projects within a consistent set higher level objectives and goals and project specific criteria, as follows:

- Project eligibility criteria – whether a project qualifies or not for funding; and
- Project selection criteria – of the eligible projects, what is the priority for funding?

Eligibility criteria were mandatory considerations, i.e. if any of the criteria were not met, the project could not be funded using MPB inventory & monitoring funding. These were:

1. *MPB affected area* – the management unit (TSA/TFL) needs to be affected by, or is expected to be affected by, the mountain pine beetle epidemic.
2. *An inventory, monitoring, update or projection mode project including associated sampling and photo imagery.* Note: "monitoring" is in an inventory context, and does not refer to monitoring programs associated with non-inventory effectiveness evaluations or monitoring to support the reporting out of criteria and indicators (e.g. for sustainable forest management plans prepared for certification).
3. *Alignment with FFT eligibility rules* if FFT funds are being used.
4. *Eligible non-timber resource inventories.* Determined as those linked most closely to forest cover mapping/VRI (e.g. where utilized to help undertake habitat supply modeling)

Selection criteria enabled the ranking of eligible projects in those of highest to lowest priority. The criteria and the ranking categories were:

1. *Immediacy of information need*
    a. Urgent - the information is urgently needed to address key inventory-related knowledge gaps due to time sensitivity issues

b. Somewhat urgent - information is needed to address key inventory-related knowledge gaps due to time sensitivity issues
c. Not very urgent - information is somewhat needed to address key inventory-related knowledge gaps due to time sensitivity issue
d. Not urgent - information would be nice to have, but would only supplement current decision information needs

2. *Degree of economic impact*
   a. very high – investment in information likely to affect decisions with very large economic consequences
   b. high
   c. moderate
   d. low – investment in information likely will only affect decisions with low economic consequences
3. *Operational need* (e.g. harvest scheduling, silviculture strategy)
   a. Critical – operational decisions require this information (e.g. to help ensure optimal return on investment)
   b. High
   c. Moderate
   d. Low – nice to have this information but not essential to making operational decisions
4. *Extent and quality of existing data*
   a. No data available leading to high decision risk
   b. Poor or insufficient data available
   c. Moderate quality data availability (e.g. age, reliability)
   d. Existing data sufficient relative to risk (low exposure)
5. *Scale of investment* (e.g. size of investment dollars to collect the information, short vs long-term commitment needed to complete)
   a. Low: single investment, with low to moderate amounts of funding, needed to collect information (i.e. not recurring annual investments expected)
   b. Moderate
   c. High
   d. Very high – project entails multi-year investments with very high total costs
6. *Quick return on investment* (see table below for ratings)
   a. Very High (VH)
   b. High (H)
   c. Moderate (M)
   d. Low (L)

Data in support of..	Low impact decision	Moderate impact decision	High impact decision
Data easily obtained	M	H	VH
Data moderately difficult to obtain	L	M	H
Data hard to obtain	L	L	M

7. *Degree of alignment with MPB Action Plan*
   a. Very high alignment – central to address this MPB Action Plan objective or needed to help address several objectives
   b. High alignment
   c. Moderate alignment
   d. Some or weak alignment – can assist in addressing objective(s) but not critical and/or other funding sources may better used to fill the knowledge gap (e.g. research)

Project Approval and Tracking

A list of priority projects, approved by ITAC and the respective technical team(s), was then drafted in preparation for the beginning of each fiscal year's work. The final list of prioritized projects, together with budget estimates, was then provided to Executive each fiscal for review and approval prior to allocation of funds. Individual project plans were subsequently drafted by the various project leads across MFR, MOE and ILMB. Projects were tracked in an ongoing manner to confirm status, address any outstanding business or technical issues, and to determine if these projects needed to carryover from one fiscal year to the next in order meet their stated objectives.

Summary of Accomplishments by Year

2005/06 Projects Summary

Project or Activity	Description	Objectives	Funding	Results/Deliverables
Air Photo Acquisition	Acquire 1:20000 Air Photo Imagery in High Priority MUs	Target of 300 mapsheets in high priority heavily impacted MUs	$2,831,000	746 mapsheets/ covering priority blocks in NIFR and SIFR and approx. 11,200,000 ha
Purchase Remote Sensing Products	Acquire RS products to help with change detection work in MPB impacted areas	Support MPB change detection and update of depletions in MPB impacted units	$200,000	RS imagery (SPOT and LandSat)
Develop a Strategy for MPB Inventory and Monitoring Projects	Determine the major business drivers and themes for guiding MPB related inventory and monitoring work	Confirm the types of inventory and monitoring work that needed to be carried out based on main business drivers and themes	$75,000	Workshop held and strategy prepared which was then used to guide project prioritization and selection
Small Scale Salvage and Major Fires Mapping	Map all major fires and SSS depletions in all MPB impacted units	Reduce the backlog in depletions	$250,000	SSS and major fire mapping backlog reduced to current year. Depletions could not be loaded to corporate database until RESULTS and VRIMS technical issues resolved
Conduct MPB Change Detection	Start up of pilot/field work to develop a change detection process for RS mapping of MPB year of attack	Determine year of attack across entire infestation back to origin	$45,000	Pilot study completed in PG area and results to be used to develop and further modify a change detection routine in 2006/07
Develop Digital Camera Specifications for use in Capturing MPB Infestations	Determine the technical specifications for DC that are needed to meet our business requirements	Improve quality and efficiency of aerial image capture	$50,000	DC specs developed and employed by BMGS and the Ministry
Critical Height Sampling	Conduct a CHS	Investigate	$200,000	Sampling completed in

Project or Activity	Description	Objectives	Funding	Results/Deliverables
(CHS)	pilot in Vanderhoof to determine if CHS would reduce sampling time and costs	improved efficiencies for ground sampling		2006 and analysis and report completed in 2007 under new recipient
Quesnel VRI Strategic Inventory Plan (VSIP)	Develop a VSIP for Quesnel that considers MPB impacts	Develop a VSIP to guide all future inventory projects in Quesnel	$65,000	VSIP delivered based on stakeholders input.
LIDAR Pilot	Enter into an agreement with UVic to run a pilot study of LIDAR in TFL 18	Investigate alternative means for acquiring accurate base data in support of determining MPB impacts on hydrology, soils, etc.	$180,000	Agreement signed and pilot project initiated (concluding in 2008)
Conduct Analysis of MPB Scenarios and Harvest Monitoring	Develop options for managing pine forests and address opportunities to mitigate mid-term TSR	Assess impacts of MPB on TSR and determine any mitigation strategies for units	$200,000	Confirmed priority MUs, collated data, initiated pilots
TOTAL COST*			**$4,096,000**	

*NOTE: FMPB funding also covered two FTEs and administration overhead of approximately $230,000 per year, not shown on these spreadsheets.

2006/07 Projects Summary

Project or Activity	Description	Objectives	Funding	Results/Deliverables
Air Photo Acquisition	Acquire 1:20000 Air Photo Imagery in High Priority MUs	Target of 400 mapsheets in high priority heavily impacted MUs	$2,200,000	534 mapsheets flown in Prince George, Ft St James, Williams Lake, Quesnel, Kamloops and Central Cariboo blocks for approx. 8,000,000 ha
Conduct MPB Shelf-life Sampling	Initiate shelf-life sampling in concert with the Federal CFS	Determine shelf-life of MPB killed pine and provide initial report on findings	$100,000	360 samples collected in SBS, initial analyses and report
Perform Site Productivity Business Case	Confirm site productivity data status in hi priority units, determine best methods for future site prod work and select hi priority units for site prod sampling	Guide site prod work by identifying high priority units and best methods/process.	$25,000	Site productivity gap analysis delivered together with a business case and list of priorities for directing future site productivity work in the central interior
Small Scale Salvage and Major Fires Mapping	Map all major fires and SSS depletions in all MPB impacted units	Update depletions to current year to reduce backlog in depletions in corporate database	$200,000	Depletions updated to 2005 and stored as a local thematic file until they can be loaded into LRDW through RESULTS and VRIMS
Red and grey Attack Mapping	Thematic updates of red and grey	Develop spatially accurate and	$90,000	Approximately 750 ortho photos were thematically

Project or Activity	Description	Objectives	Funding	Results/Deliverables
	attack mapping based on 750 2005 ortho photos	current red and grey attack mapping to guide mitigation efforts and other strategic and operational needs		updated to show extent and location of red and grey attack and severity
MPB Spread Model Calibration Sampling	Conduct sampling in all units to confirm or modify MPB spread model	Improve future MPB spread estimates to more accurately forecast future impacts across all units	$125,000	Data collected from approximately 260 samples to be used in calibrating the spread model and improve forecasting
MPB Change Detection Operational Trials	Conduct operational trial of RS imagery and sample data to develop change detection process	Determine year of attack across entire infestation area back to origin	$100,000	Change detection process developed and automated for use in producing map of dead in 2007/08. spatial results will be tied to shelf-life data
Growth and Yield Plot Measurement and Re-measurement	Locate, measure and re-measure GY plots in MPB units	Obtain data to assess MPB impacts on GY in pine and non-pine species	$200,000	177 GY PSPs re-measured to obtain data on current and future volume in pine and non-pine species
Support NCC Eco-regional Assessment of the Central Interior	Conduct an eco-regional assessment for the central interior in MPB impacted areas	Produce eco-regional assessment of habitat in light of MPB impacts and depletions, develop a central repository on the web to guide operational and strategic planning	$300,000	Multi-year ongoing to 2009 – results pending Technical working groups formed, data collated and initial analyses run
Conduct Non-timber Inventory Projects	MOE-led projects to complete watershed sensitivity in 7 units and watershed classification in MPB interface zones	Assess MPB impacts on watersheds to guide MPB mitigation activities	$265,000	Database and reports submitted to MOE
Conduct Analysis of MPB Scenarios and Harvest Monitoring	Conduct enhanced TSR assessments and harvest performance monitoring	Assess impacts of MPB on TSR and determine any mitigation strategies for units	$200,000	Completed harvest scenario development and initiated harvest performance monitoring for priority MUs
TOTAL COST			**$3,805,000**	

2007/08 Projects Summary

Project or Activity	Description	Objectives	Funding	Results/Deliverables
Air Photo Acquisition	Acquire 1:20000 Air Photo Imagery	Target of 300 mapsheets in high	$1,000,000	217 mapsheets flown for Nadina and Okanagan

Project or Activity	Description	Objectives	Funding	Results/Deliverables
	in High Priority MUs	priority heavily impacted MUs		blocks covering approx. 3,250,000 ha
Conduct MPB Shelf-life Sampling and Analysis	Continue from the 2006 shelf-life sampling by sampling over the representative range of ecosystems (BEC)	Complete comprehensive survey across all BEC sub-zones to assess shelf-life of MPB killed pine and model results into spatial database (Map of Dead)	$100,000	101 samples collected across all BEC sub-zones, calibrated to scale information, spatial modelling to link shelf-life volume and value depletion tables to Map of Dead
Conduct Site Productivity Sampling and PEM	SIBEC sampling, accuracy assessment and PEM generation for priority units in collaboration with licensees	Improve site productivity information to better inform TSR and silviculture investments in areas depleted by MPB	$300,000	SIBEC and PEM sampling underway in Quesnel, Williams Lake and 100-Mile units. This is multi-year work continuing to 2009.
Conduct Lakes VRI Ph 2 and NVAF	Complete inventory ground sampling and include MPB impacts for next TSR	Provide data to determine mid-term TSR impacts from MPB	$160,000	Phase 2 enhanced ground sampling and NVAF completed for Lakes. VRI data package delivered for TSR.
Complete MPB Change Detection	Determine MPB year of attack across entire infestation to derive map of dead	Support spatial determination of FFT footprint, inform TSR, guide strategic and operational decision making	$40,000	Map of dead to be completed in March/08
Complete Merritt NVAF	Conduct NVAF ground sampling in Merritt	Provide current and accurate data on MPB impacts	$60,000	NVAF sampling completed and data delivered for inventory adjustments
Conduct Non-timber Inventory Projects	6 high priority MOE-led projects to assess impacts on watersheds, access issues, water quality monitoring	Provide data to assess MPB impacts on water quality and wildlife	$400,000	Reports and data available pending project completion in March/08
Conduct Analysis of MPB Scenarios and Harvest Monitoring	Complete MPB analysis	Assess impacts of MPB on TSR and determine any mitigation strategies for units	$140,000	Harvest scenarios and performance monitoring completed for priority MUs, final report delivered
TOTAL COST			**$2,200,000**	

NOTE: Funding cuts in 2007 forced a reduction in the scope of flying over some identified priority units and these dropped areas, together with some new infestations reported in the north east, account for a gap of approximately 100 to 150 mapsheets at the conclusion of the programme.

Air Photo Acquisition and Production of Digital Ortho Photos

Approximately 22.4m ha were covered under the three-year FMPB funded flying projects, which represents the majority of the infestation. Many areas that had imagery five or more years old were re-flown in order to provide critical updates in light of the epidemic. The imagery from 2005/06 was also used to produce accurate red and grey attack mapping which is now being incorporated into the overview map of the dead to show year of attack. Remote sensing imagery is filling gaps in the red and grey attack mapping coverage. It is expected that the ortho imagery will support spatial determination of the FFT footprint – areas with high potential for follow-up surveys and treatment activities under FFT – as well as provide critical strategic level information for identifying reserve areas. As well, this imagery has been supporting the development of silviculture type 2 strategies in heavily impacted management units, and is expected to provide similar benefits for the next few years. Thus, in summary, this imagery continues to provide forest resource managers with current and accurate information on MPB location and extent over the majority of the infestation. Please refer to the air photo acquisition overview maps in the appendix to see the blocks covered by year from 2005 through 2007.

MPB Related Ground Sampling Activities

Ground sampling covered a number of critical priorities, including shelf-life sampling, establishment and measurement of monitoring plots, enhanced VRI phase 2 sampling, and calibration of the MPB spread model. Ground data was then used to inform TSR analyses in heavily impacted units (this work is still ongoing), provide data to confirm the MPB spread model and modify it for MPB spread in younger stands, and to calibrate the MPB change detection process to derive as accurate as possible a map of the dead which shows year of attack. In addition, MPB shelf-life sampling data is being employed for the second round of shelf-life modelling the results from which will be linked to the map of the dead to better inform forest resource decision makers. Site productivity sampling is well underway in three critical management units, Quesnel, Williams Lake and 100-Mile House. This information is critical to future TSR forecasts as well as providing guidance for silviculture investments. Some funding also covered inventory project planning support, specifically the development of VSIP, VPIP and project management specific to the development of innovative air and ground sampling techniques to capture understory information and undertake site productivity sampling.

Broadly speaking, ground sampling activities have collected information which informs both current location and extent of the infestation as well as providing information used to determine current and future volume and value impacts. A number of monitoring plots and growth and yield plots were established that should also provide some broader measures of impacts on ecological values, although it should be noted that monitoring is one of the major future gaps in our knowledge base that should be addressed.

Remote Sensing and Depletion Updates

These projects and activities have been focussed on development of retrospective change detection and a MPB map of the dead and shelf-life model across the entire infestation. In addition, remote sensing imagery acquisition was also supported in the first year of this programme. A number of key products are slated for completion and distribution in the spring of 2008, including small scale salvage (SSS) update and major fires update using remote sensing imagery and change detection to keep depletions current. These data will form part of the update backlog to be loaded into the corporate warehouse through the Kamloops and FAIB update process. Other key products for use by FFT and other forest resource decision makers are red and grey attack mapping and the retrospective change detection derived map of the dead, which shows MPB attack by year for all pine stands across the entire infestation. In 2007 testing of a digital camera system (DCS) was also initiated in order to assess methods and accuracy for determining understory inventory in areas where mature pine canopy has been killed. These products are being assembled to assist FFT in the spatial determination of areas with high potential for follow-up aerial and ground surveys to efficiently direct site rehabilitation activities.

Non-timber Inventory Work

As part of the annual business planning process, MOE administered priority non-timber projects in heavily impacted management units. A total of 7 districts were assessed for MPB related impacts on fish bearing streams and water quality, including support for hydrometric monitoring in critical areas. The effects of increased access on critical wildlife species were assessed. The results from these projects will be used to determine follow-up mitigation strategies where required. In addition, the MFR, MOE and ILMB entered into an agreement with the Nature Conservancy of Canada (NCC) for the completion of an eco-regional assessment of the southern interior. This multi-year undertaking, scheduled for completion in 2009, will provide MFR and other key stakeholders with an assessment of habitat suitability and risks to aquatic and terrestrial wildlife across the MPB impacted central interior and will provide information to guide future strategic planning.

Identified Gaps

While much was accomplished from 2005 to 2008, FMPB funding has concluded before originally anticipated since the first three years of funding were supposed to have been followed with up to ten more years of FMPB funding for inventory and monitoring. The Federal Government has opted to follow the MPB spread into Alberta and has also opted to focus any future spending in the area of impact mitigation in local communities, together with another year of suppression activities. This change in direction leaves any support for continuance of MPB related inventory and monitoring directly with the Province, through FFT funding. In order to fund carryover work a number of critical

gaps were first identified. The following is a summary of remaining gaps in our information that have been identified together with some options for addressing these gaps.

High Level Drivers and Objectives	FMPB	FFT	Dropped/Gap	New Project or Activity	Benefits or Rationale
Determining current and future location and extent (MPB Attack)	1:20,000 air photo acquisition	Dropped	1:20,000 air photo acquisition (completed under FMPB except for 100 to 150 mapsheets)		Funding constraint
	Red and grey attack mapping	Continued as annual updates			Provides accurate and current map of dead and red and grey attack themes needed to support FFT footprint and operational activities
	SSS and major fires updates	Continued as annual updates			Reduces backlog of SSS blocks in VRIMS and RESULTS and provides spatial location of all depletions to support FFT footprint and operational activities
	Establishment of monitoring plots	Dropped	Establishment of monitoring plots to assess performance, CC and C trends, etc.		Would provide critical information for CC&C analyses and reporting purposes. Dropped due to funding constraint.
Determining current and future volume and value	Phase 2 VRI sampling	Dropped	Phase 2 VRI sampling (to be done under FIA for those portions of the MU outside of MPB?)		Carried under FIA and augmented by DCS and complex stands amalgamated surveys
	Inventory planning support	Dropped	Inventory planning support (to be covered under FIA)		Carried under FIA
	Shelf-life and NVAF sampling and analysis	Dropped	Shelf-life and NVAF sampling and analysis (completed in 2007-08)		Some follow-up modifications to the shelf-life model are required. Any further sampling has been dropped due to funding constraint.
	PSP measurement and re-measurement	Dropped	PSP measurement and re-measurement (funded under GY)		Carried under GY funding
	TSR analysis for spread projection, scenarios, harvest monitoring	Continued			Support critical TSR analyses and decisions in MPB impacted MUs. Provide data to support CC&C

High Level Drivers and Objectives	FMPB	FFT	Dropped/Gap	New Project or Activity	Benefits or Rationale
					reporting needs
	Site productivity (SIBEC and PEM)	Continued			Provides accurate and current site productivity information to support silviculture investments, FFT footprint and operational activities Provide data to support CC&C reporting needs.
	Quesnel VRI Phase 1 Inventory Pilot	Dropped	Quesnel VRI Phase 1 Inventory Pilot (completed in 2007)		Pilot completed and any VRI to be carried under FIA funding. Recommendations from pilot may be considered under FFT sampling approach
Conducting inventory work for non-timber values	NCC eco-regional assessment	Dropped	NCC eco-regional assessment (to be completed in 2008-09)		Completed
	Watershed sensitivity analysis	Dropped			Funding source not identified
	Fisheries watershed classification	Dropped			Funding source not identified
	Access and key population inventories	Dropped			Funding source not identified
Defining the FFT Footprint		Review tools and products for collaborative sampling in complex stands - understory component		Review tools and products for collaborative sampling in complex stands - understory component	Critical for spatially defining the FFT footprint for immature and mature pine stands across priority MUs in support of most cost efficient and timely FFT operational activities
		Conduct collaborative and Innovative Inventory Aerial Sampling		Conduct collaborative and Innovative Inventory Aerial Sampling	Confirm areas for follow-up treatment and collect critical data for silviculture and inventory as part of the FFT footprint for immature and mature pine stands across priority MUs Provide data to support CC&C reporting needs.
		Conduct collaborative Inventory Ground Sampling		Conduct collaborative Inventory Ground Sampling	Confirm areas for follow-up treatment and collect critical data for silviculture and inventory as

High Level Drivers and Objectives	FMPB	FFT	Dropped/Gap	New Project or Activity	Benefits or Rationale
					part of the FFT footprint for immature and mature pine stands across priority MUs. Provide data to support CC&C reporting needs
		Capacity, outreach and extension activities		Capacity, outreach and extension activities	Provides training and communications in support of local FFT staff and RAHs
		Development of a project and activities tracking tool for FFT and FIA		Development of a project and activities tracking tool for FFT and FIA	Not yet funded. Would provide improved project tracking across FFT and FIA for each management unit.

Recommendations and Opportunities

A number of key recommendations have been identified to cover many of the critical gaps that have been identified. To fill this need a number of projects and activities are recommended to continue under FFT funding, as summarized in the following table.

Initial list of proposed projects and costs and total cost estimates from 2008/09 to 2010/11:

Proposed Project or Activity	2008/09 Cost Estimate	2008/09 Notes/Comments	2009/10 Cost Estimate	2010/11 Cost Estimate
SSS and Major Fires Update	$100,000	All MUs – complete backlog and then keep current to year	$100,000	$100,000
Update Red and Grey Attack and "map of the dead"	$50,000	All MUs – keep current to year	$50,000	$50,000
Complete SIBEC and PEM	$600,000	Focus on SIBEC completion in Williams Lake, 100-Mile. Other MUs to be confirmed after 2009	$300,000	$300,000
Capacity, outreach and extension activities	$25,000	Better communications, training in access to and use of imagery and other inventory	$25,000	$25,000

		information		
Review tools and products for collaborative sampling in complex stands - understory component	$75,000	Standardized sampling regime and procedures and standard data collection defined for both silviculture and inventory	$0	$0
Conduct collaborative and Innovative Inventory Aerial Sampling	$400,000	Quesnel and other MUs to be determined	$400,000	$200,000
Conduct collaborative Inventory Ground Sampling	$800,000	Quesnel and Lakes, Other MUs – 100-Mile, PG and Williams Lake – TBD Focus on young stands, non-PI	$700,000	$400,000
Analysis*	$200,000	Annual continuation of MPB scenarios, uplifts, harvest monitoring, changes to the MPB spread model for younger stands	$100,000	$100,000
Optional CMI Plots**	Not included	Quesnel, Lakes, others TBD – 100 plots per year	Not included	Not included
TOTAL COSTS	**$2,250,000**		**$1,675,000**	**$1,175,000**

*Note – analysis work is $200,000 per year plus 2.2 FTEs already covered. Funding for this activity may be reduced to $100,000 per year.

**Note – establishment and re-measurement of CMI plots an additional option at approximately $250,000 per year (not included in the above total costs).

Recommendations stemming from the October 23, 2007 complex stands workshop and a concurrently issued questionnaire are the driving factor behind a number of the above listed projects and activities. These recommendations are summarized as follows:

- Undertake complex stands work organized under five identified complex stand themes, as follows:

    1. Collaborative Planning, Prioritization and Sampling (now to mid-term 2-4 years);
    2. Surveys, Data Collection and Standards Harmonization (now to mid-term 2-4 years);
    3. Growth and Yield Projection and Modeling Innovation (now for 5-10 years);
    4. Systems Integration and Change Management (now for 5-10 years); and,
    5. Project Management & Support Team (now and ongoing through all themes)

- Follow a number of next steps in order to move the entire initiative forward, including:

a. Workshop-follow-up (by November 30)
b. Preliminary project organization and securing management support (by Dec. 31)
c. Project team and business case development (By Jan. 31, 2008)
d. Business case approval and develop the project plan (by Feb. 29, 2008)
e. Execute the plan, implement and monitor (March 1 2008+)

- Determine an overall Steering Committee and executive sponsor. Some of the "quick wins" can proceed as stand alone priority projects; however, proceeding in full would be contingent upon MFR executive endorsement of a business case, allocating resources, and approving a one year project and subsequent change initiatives. ***Note: Work is already underway on some of the quick wins.***

- Continue with the Inventory and Timber Analysis Committee (ITAC) in its current role to address theme 2 and many aspects of theme 1.

- Oversight of theme 3 should be through the Growth and Yield Program Coordinating Committee (GYPCC).

- Teams for the other themes 4 and 5 should be appropriately adapted in membership expertise and would then need initiation.

- Develop a business case for this initiative and include the cost/benefit of better inventory of complex stands, including consideration of internal and external resources capacity and the impact and risk assessment of the decisions to be made. Note: This business case is needed because the information and data collection in complex stands must have a decision-focused design. It must be clear what the users want for what decisions, and if those decisions warrant the level of information, method cost and time required.

Opportunities - from Themes for Action Planning and Teams

1. Collaborative Planning, Prioritization and Sampling:
   a) Identify the priority MPB Mgmt Units (TSAs or TFLs) with the greatest short to mid-term fall down i.e. Quesnel, Prince George (Vanderhoof).
   b) Create and maintain a map and simple register for the multiple data use/collection projects occurring in the field, within a management unit.
   c) Ensure effective communication and stakeholder involvement in collaborative planning and sampling. **Note: Organization and access to photos, surveys, and maps etc. is to foster positive relations and co-operation between users in a timely and efficient manner.**

2. Surveys, Data Collection and Standards Harmonization
   a) Review remote sensing imagery and associated mapping products needed to support spatial identification of areas with high potential for inclusion within the FFT footprint.
   b) FFT to pilot test digital camera sampling of MPB-impacted mature forests during winter of 2007/2008, followed by ground calibration in 2008/2009.
   c) Review and identify options for changing/adding attributes in complex stand models, including better use and integration of silviculture and other field survey data
   d) Determine the best attributes/sampling methods for complex stand models.
   e) Support the integration of survey information into the data mgmt systems. (see Theme 4 System Integration)
   f) Promote the utilization of hand-held digital recorders for surveys and cruises.

g) Conduct a review of inventory ground samples similar to above review of models and use of silviculture and other field survey data.

3. Growth and Yield Projection and Modeling Innovation

a) Examine how other jurisdictions model complex stands.
b) Examine how other jurisdictions are approaching carbon models (vis a vis G & Y and the range of other factors including soil).
c) Examine existing research projects that have looked at secondary structure as a basis for predictive modelling.
d) Explore if existing models could be enhanced to more adequately deal with complex stands and/or the need for a new model &/or software.
Note: Developing a new model can takes years and cost millions.
e) Determine an appropriate model and method for carbon accounting.

4. Systems Integration and Change Management

a) Review the potential areas of integration of the existing data and determine the utility of doing so.
b) Mine the existing database
c) Build an assessment of spatial variability into the data collection and inventory labels. (Part of theme 2 as well.)
d) Similarly, utilize silviculture surveys of major fires to revise the label and include regenerated trees/vegetation
e) Review the "optional" information already collected in RESULTS database using the lens of complex stands, with a view to improving the complex stand inventory
Note: Implementing data base and systems changes can cost millions and take years of effort.

As well, there are a number of recommendations for improving and continuing the project administration framework, as follows:

- Continue overall inventory project review and administration through ITAC committee for those projects funded via FFT.

- Review and revise the ITAC Terms of Reference as appropriate for the committee to continue in its inventory projects oversight role.

- Continue with annual reviews and prioritization of ongoing and any new projects proposed for funding using a standard approach to project selection.

- Work with BMGS to improve their image quality assurance process and access to imagery. BMGS should ensure that Ministry staff and licensees receive advanced news of any QA issues with respect to imagery prior to these files being delivered to the Ministry. As BMGS needs to provide easier access to information without fees.

- Revise the FFT website to better facilitate communications and outreach, especially in support of rolling out the FFT footprint mapping products to FFT regional staff and recipient agreement holders (RAHs).

- Load and manage all project deliverables in a central, accessible repository: Marble server and LRDW for inventory and monitoring project spatial and attribute data, the FFT website for all project reports, and the MOE server for all non-timber inventory projects led through MOE.

- Develop a central MPB projects tracking tool to cover both FFT and FIA funded projects, summarized by management unit, description and results. Ensure that this tool is updated by project leads on a regular basis and that it is accessible by all agencies and stakeholders.

- Confirm funding source for any future MOE-led non-timber inventory work not continued through further FMPB funding.

- Complete modifications to the initial MPB shelf-life model and MPB spread projection model based on sample data collected in 2006 and 2007.

- Continue to track the NCC project to complete an eco-regional assessment of the central interior to confirm deliverables from this initiative will continue to meet Ministry needs in addition to the needs of other stakeholders.

- FAIB should review its monitoring objectives in light of climate change and carbon sequestration data needs, analyses and reporting. These drivers are crucial to both the federal and provincial governments yet monitoring was not determined to be a priority activity for FFT funding despite the additional information that could also be provided in terms of stand performance.

Appendix

Links to referenced background material:

The 2006-2011 Mountain Pine Beetle Action Plan

http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/actionplan/2006/Beetle_Action_Plan.pdf

http://www.for.gov.bc.ca/hts/MPBStrategy/StrategyReport_Final_Jun17.pdf

Data Locations:

DIMS Server MPB ftp on Air Photo Imagery (Orthophotos)

http://www.basemaps.gov.bc.ca/

Marble Server MPB Remote Sensing Information (Contains Spatial and non-spatial Data) and project reports

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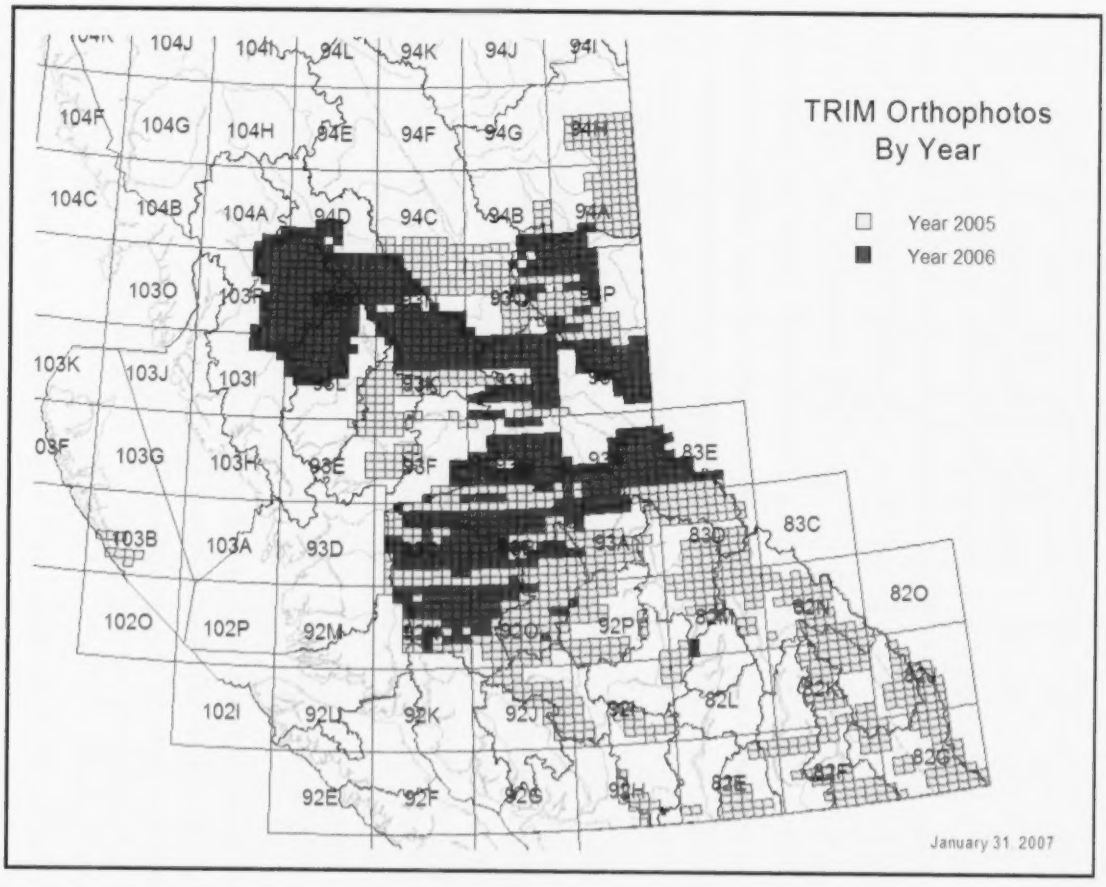
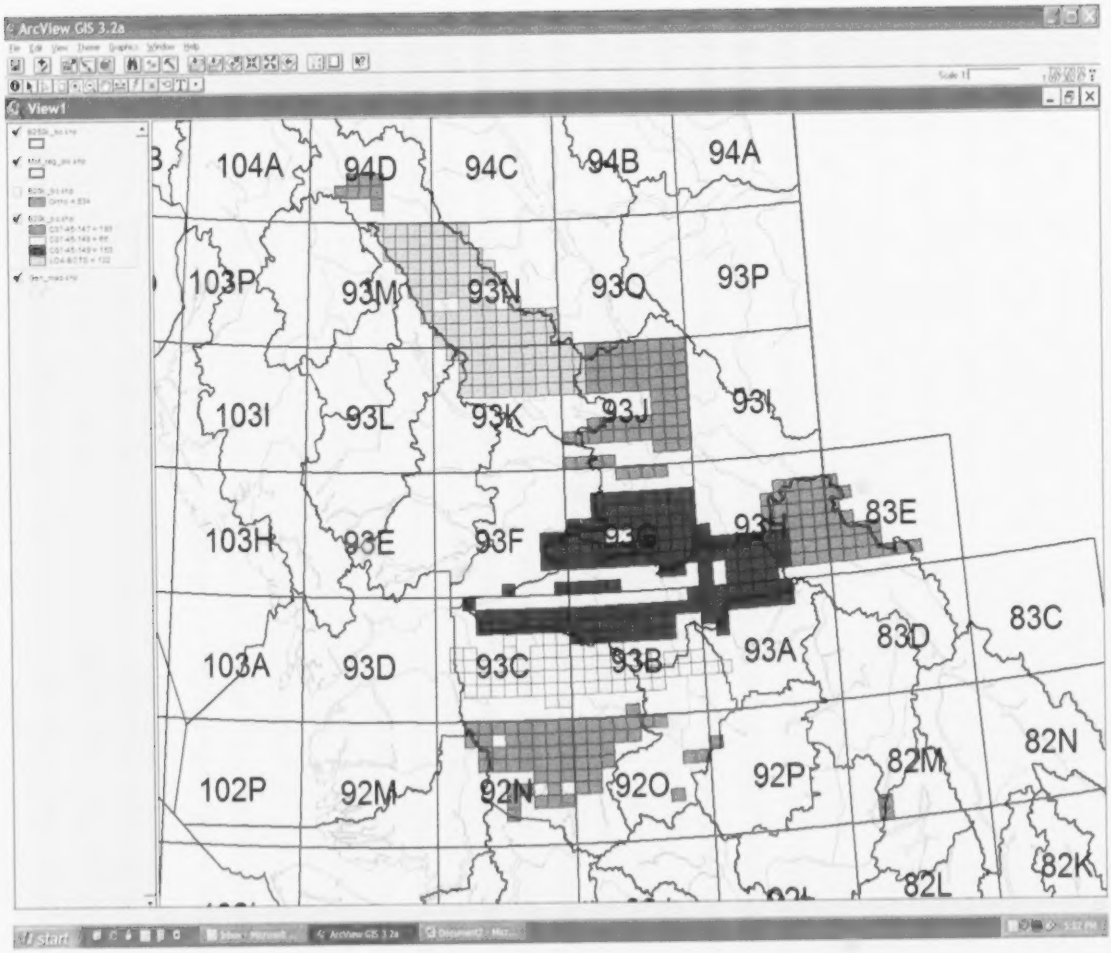
Air Photo Overview 2005-2008

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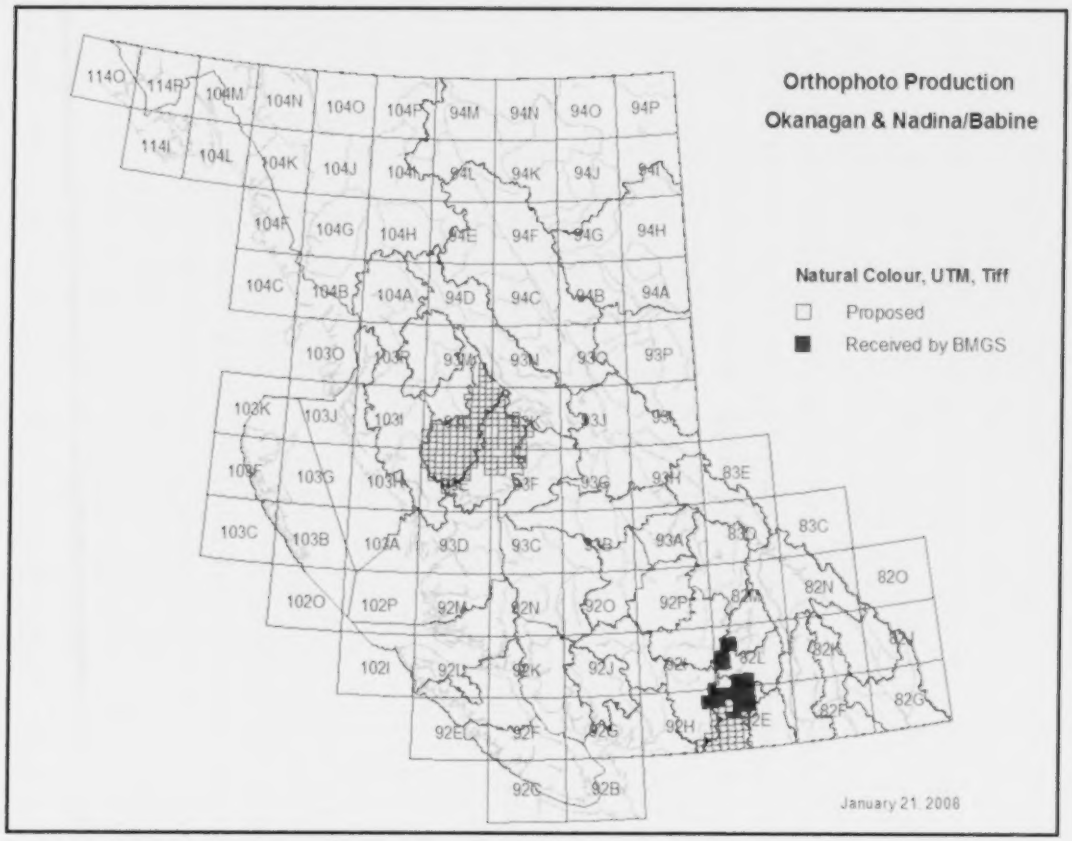
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